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AUTHOR Grant, Linda; And Others
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ABSTRACT

This study explores the dynamics and effects of mentoring relationships, with particular emphasis on the experiences of women and minorities as proteges. It draws upon quantitative and qualitative data gathered from a survey of 587 academic scientists and interviews with 55 academic scientists, in 3 disciplinary areas: physics and astronomy, chemistry and biochemistry, and sociology. Results are analyzed in terms of effectiveness of mentors, access to eminent mentors, advantages and disadvantages of mentors, gender neutral themes, gender specific themes, problematic relationships, race/ethnicity-linked themes, collaboration, other mentors, and consequences of the mentoring experience. The study concludes that women and minority scientists, overall, appear to find the mentors they need for career success, have effective mentoring relationships with doctoral and postdoctoral advisers, and find other mentors when necessary. Problems in mentoring relationships include difficulty in gaining access to the eminent mentors whose sponsorship can help to jump start their careers and a series of gender-related and race-related difficulties in sustaining mentoring relationships within the academic system. (Contains 31 references.) (JDD)

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Mentoring, Gender, and Careers of Academic Scientists

by

Linda Grant
Department of Sociology and
Institute for Behavioral Research
University of Georgia
Athens, Georgia 30602

Kathryn B. Ward
Department of Sociology and
Women's Studies Program
Southern Illinois University
Carbondale, Illinois 62901

and

Carrie Forshner
Department of Sociology
Southern Illinois University
Carbondale, Illinois 62901

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Introduction

Mentoring has been identified as a critical factor in entry and survival of women and minorities in social, natural, and physical sciences where they are underrepresented (Task Force 1988). Having an effective mentor, it is argued, aids completion of degree, receipt of funding for research, and publication of scholarly research, all essential for academic career growth in these disciplines (Blackburn 1981; DuBois et al. 1985; Fox 1983, 1989; Hornig 1987; McGinnis and Long 1988; Ramaley 1978; Zuckerman 1990).

Mentors can provide instrumental resources and emotional support for beginning scholars, but research suggests that women and minority scholars might have greater difficulties than white men in finding mentors and developing successful relationships with them. Women in some disciplines collaborate less with mentors than do men, an important disadvantage since collaboration is linked to favorable job placement and early productivity.

Furthermore, women scholars might be more likely to encounter negative, exploitative forms of mentoring (CEEWSE 1983; Collins 1983; Long 1987, 1990; Menges and Exum 1983; Rossiter 1982; Task Force 1988; Vetter 1988). Minority scholars may have special problems finding suitable and mentors and only rarely find mentors who share their status configurations (Brewer 1988; Collins and Matyas 1985; Kahle 1986; Malcolm et al. 1979; Mirande 1988; Rosser 1990.) A good experience with a mentor might provide an step up that provides cumulative advantages over the course of a career, while a less effective experience might begin a pattern of cumulative disadvantages that keeps women and minorities at what Zuckerman, Cole, and Bruer (1991) have termed the "outer circle" of their disciplines.

Most research on mentoring in postsecondary institutions examines only access to mentors, giving little attention to the content and context of mentoring. Further, much research assumes that mentoring always is advantageous and does not explore the nature and impact of negative forms of mentoring. One negative form of mentoring is cooptation (Collins 1983). Women and minorities might ener academia with distinctive substantive foci, methodological preferences, and ethical orientations and might be subjected to pressures from mentors, albeit well-meaning, to abandon these distinctive stances to take on those of the mainstream of their disciplines. Also, mentoring styles successful with white men might not be as effective with underrepresented groups. Thus, mentoring needs to be conceptualized as a complex, negotiated relationship, and the dynamics of successful and unsuccessful mentoring relationships need further exploration.

This study explores dynamics and effects of mentoring relationships, with particular emphasis on on the experiences of women and minorities as proteges. It draws upon quantitative and qualitative data gathered from academic scientists in three disciplinary areas: physics and astronomy; chemistry and biochemistry, and sociology. We consider the following questions: How accessible and effective are mentors of women and minority scientists, as compared with mentors of white males? What particular difficulties do women and minority scholars face as proteges in mentoring relationships? How does gender affect opportunities for collaboration with one's mentor? What are the consequences of collaboration and effectiveness of the mentoring relationship on research productivity?

Sample and Methods

These questions are addressed using two information sources: a recently completed survey of a national random sample of 587 women and men scientists

currently employed in U.S. universities and 55 intensive interviews, conducted by the second authors and concentrated primarily on women and scientists of color. Included in the interviews were persons who were African American, Puerto Rican, Chicano/a, Asian, Asian American, and White.

The survey was send to a national random sample of 200 women and 200 men in each of the three disciplines.[1] All were currently employed in tenured or tenure-track positions in U.S. universities offering doctoral programs in their respective disciplines. Respondents were selected from 1990 disciplinary directories, except for women physicists, who were selected using lists maintained by of the Committee on the Status of Women in Physics. (More detail on sample are given in Grant and Ward 1992). Overall usable responses were obtained from 587 scientists, or 49 percent. Table 1 shows, that response rates varied by discipline, but were consistently higher for women than for men.

TABLE 1 ABOUT HERE

Questionnaires took about 60-90 minutes to complete and covered a wide range of issues related to personal history, academic training, experiences with doctoral and postdoctoral mentors, research productivity, and current involvement in mentoring of students and more-junior colleagues. They contained closed-ended and open-ended items. Less than 5 percent of respondents were ethnic minorities. Therefore, survey data could be analyzed for gender, but not race/ethnicity effects. Intensive interviews covered experiences of minority scientists and gathered detailed information on mentoring experiences of white women, allowing some exploration of minorities' experiences. Surveys were analyzed using quantitative and qualitative techniques. Interviews and open-ended questionnaire items were analyzed using techniques of analytic induction appropriate for qualitative data (LeCompte and Goetz 1984; Strauss and Corbin 1990).

Men in each field were more senior in rank than the women overall. In all disciplines, a majority of men were tenured, while a majority of women were not. Men were of significantly greater professional age than women in all disciplines, having received degrees, on the average, five years earlier in sociology, seven years earlier in chemistry, and 11 years earlier in physics and astronomy. Therefore, in quantitative analyses it was important to control for professional age, measured here by year of degree. The majority of scientists were currently or previously married. There was a significant gender difference in marital history for physicists and astronomers (91.4% of men had been married as compared with 74.1% of women), but not in chemistry (87.5% men versus 85.3% women) or sociology (89.4% men versus 81.6% women). In all disciplines women were less likely to have had children: 77% of men versus 49% of women in physics; 78% versus 60% in chemistry; and 80% versus 53% in sociology.

Effectiveness of Mentors

We first examined the availability and effectiveness of mentoring that women and men scholars received in graduate and postdoctoral training. Scientists were asked to rate the effectiveness of their doctoral advisers and postdoctoral supervisors, respectively, as mentors for them. Ratings were on a four-point ordinal scale with responses of 4=very effective; 3=moderately effective; 2=somewhat effective; and 1=not very effective. Open-ended items then asked respondents to comment on advantages and disadvantages of their advisers and postdoctoral supervisors as mentors for them.

TABLE 2 ABOUT HERE

Table 2 shows ratings of advisers and the first postdoctoral supervisors for women and men scholars in the survey sample. Across disciplines women and men averaged moderately high ratings to doctoral advisers. Only ratings by women

physicists and astronomers averaged below the "moderately effective" point on the scale, and only for this discipline were there significant effects by gender. Thus, the majority of respondents had been well mentored by doctoral advisers. Postdoctoral advisers were similarly well-rated by scholars who had held such positions, the only significant gender difference occurring in sociology, where few scholars had done postdocs. Male sociologists rated postdoctoral supervisors higher than did female sociologists (Table 2). These patterns are not surprising, since the sample included only those scientists who had obtained a tenured or tenure-track position in a doctoral-granting department.

In physics and chemistry, the overwhelming majority of doctoral advisers had been male (98% and 94%, respectively), so it was not possible to examine effects of interrelationships of gender of adviser and gender of protege. However, in sociology there were sufficient numbers of scholars with female doctoral advisers to make such comparisons possible. Of the sociologists, 22 (16 women and 6 men) had worked with female doctoral advisers. Females sociologists with female advisers gave them the highest rankings (3.2). The next highest rating was given to male advisers by male sociologists (3.0), followed by a mean rating of 2.8 for female scholars with male advisers and 1.8 for male scholars with female advisers. This is a statistically significant distribution. Of the 6 men who had worked with female advisers, 3 had acquired advisers late in their doctoral work after disputes with other advisers or after previous advisers had left their departments. Further, in all but one case the female adviser was an assistant professor. In these cases the female advisers' junior status appeared to be confounded with her mentoring activities, with proteges complaining in followup questions that their advisers were unknowledgeable and lacked power in reference to departmental procedures and had limited networks in the discipline.

The single male respondent who had worked with a woman full professor, chosen because of common interests, rated her as a very effective mentor.

Access to Eminent Mentors

Women were disadvantaged in working with particularly eminent mentors, whose sponsorship has been linked in prior research to distinctive advantages in the early career phase (Cole 1987; Zuckerman et al. 1991). We defined eminent mentors as those who were Nobel Laureates and/or members of the National Academy of Science. Only 8 scientists (6 men and 2 women) had worked with eminent mentors, a statistically significant difference (X-square=7.22, p=.03). None of the minority scientists interviewed had worked with eminent mentors. One white woman survey respondent wrote of being turned down by an eminent scientists with whom she had hoped to work, with his telling her: "I don't allow any women in my lab." No one at her institution challenged the senior scientist's actions and she thus was unable to work in the particular subfield of physics she had chosen.

Advantages and Disadvantages of Mentors

In open-ended followups probing advantages and disadvantages of doctoral advisers and postdoctoral supervisors as mentors, scholars in all disciplines mentioned several themes that might be thought of as gender neutral, or mentioned as frequently by women and by men. Other themes were gender-specific, or mentioned more frequently or exclusively by persons of one gender. Most of the latter were themes raised by women. Although a few themes were more prevalent in one discipline than in others (e.g., access to high technology laboratories, more relevant for physicists and chemists than sociologists), there were more similarities than differences across disciplines in assessments of advantages and disadvantages of these mentors.

Participants' comments about positive and negatives of mentors are quoted at some length, since they provide insights into the dynamics of successful and unsuccessful mentoring relationships.

Gender-Neutral Themes

In all disciplines women and men valued advisers and supervisors who displayed a combination of fine scientific ability and strong interpersonal skills. They praised scholars who were supportive, critical, up to date in their areas, enthusiastic about their work and that of their students and postdoctoral associates, available and attentive to their proteges' work, and concerned about students and junior scholars as people as well as scientists in training.

Descriptions given by women and men of such advisers and supervisors were similar, and effective male and female advisers were described as having similar characteristics. The following excerpts illustrate:

> A talented and inspiring scientist who always had time for his students. An infectious enthusiasm for my work, even though it was different from the main focus of his. Always available to discuss ideas and give guidance. A fine human being who made me feel valued as a person.
> (Female chemist, male doctoral adviser)
>
> * * *
>
> Insightful, daring, technically spectacular. Well regarded by students and by national and international peers, yet a fully decent person with a life outside of the laboratory. A superb role model. A gifted teacher.
> (Male physicist, male postdoctoral supervisor)
>
> * * *
>
> Had faith in me. Convinced me that I could do chemistry. Had a good deal of confidence in me during the three years I worked in his laboratory.

(Female chemist, male doctoral adviser)

Women and men also valued advisers and supervisors who prepared them well for their future as researchers and provided professional socialization, as in the following description:

> Had weekly group meetings on research project. He made a point to designate a major portion of the research as an area where I would have primary responsibility. General socialization into the profession--grant proposals, journal submissions, revise and resubmits. Not a prima donna or deluded by notions of genius. Communicated pragmatism and craftspersonship.
>
> (Female sociologist, male doctoral adviser)

The combination of strong scientific and interpersonal skills appeared in both women's and men's descriptions of successful advisers. Further, many who had experienced more successful postdoctoral than doctoral advising relationships noted that when selecting a postdoctoral supervisor, they had searched explicitly for someone who had interpersonal skills along with scientific abilities. One women chemist who had made such a search commented:

> Scientific skill without communicative ability is largely wasted, at least in the role as a teacher. Hostile treatment of students is NOT the best way to encourage them to do high-quality work. I had to learn that the hard way that the environment in which I worked was very important and that I could not respect a rude and abusive person, no matter how brilliant a scientist he was.

A woman physicist commented that in graduate school she held a largely-unconscious belief that good scientific skills and good interpersonal skills were incompatible. By the time she searched for a postdoctoral position, however, she

realized that "....this is really a four-celled table with a good scientist/decent person cell.....I searched for a postdoc supervisor who fell into this category. I did my homework carefully!"

Some types of disadvantages in relationships with mentors were equally prevalent among women and men. Scholars recalled problems working with advisers or postdoctoral supervisors who were inattentive to students' or associates' work, exploitative and unwilling to give fair credit for work, poor scientists and/or administrators, inaccessible due to overwork and/or frequent travel, too junior to have power inside or outside their departments, and unwilling or unable to support the junior scholar on the job market.

A woman chemist who rated her postdoctoral supervisor as not very effective noted as follows:

> He did not challenge my abilities or engage me in problem-solving. Instead, I was assigned routine tasks below my ability and experience. Scientifically, his lab was "sloppy" compared with compared to [some she had worked in previously]. He was more interested in the "glitz" than in chemistry.

A male sociologist, displeased with his female adviser, attributed most problems to her heavy workload and junior status:

> I really didn't have a mentor who helped at all. Each one left before I finished. I used an assistant professor who would let me through easily. She was preoccupied with her own work and learning to teach. She had no extra-university contacts or networks. The biggest advantage was that she didn't do anything to keep me from finishing.

His assessments were echoed by a woman physicist who had worked with a male assistant professor, who wrote that although her adviser had been kind and

supportive that "He was not taken very seriously [in the department. I was his first doctoral student and he was very 'green' about the process and still learning the ropes."

Gender-Specific Themes

Some assessments of advantages or disadvantages of mentors were gender-skewed. Although the themes appeared in assessments of women and men advisers and supervisors by women and men junior scholars, they appeared more often in assessments of advisers of one gender more so than the other. Junior scholars were more likely to identify same-gender mentors as good role models, consistent with Epstein's (1970) argument that mentors and role models can be differentiated. Mentors, who may have any race or gender characteristics, support and encourage the work of a junior scholar and impart knowledge and encouragement supportive of achievement. Role models can do more by illustrating the openness of the system to persons of the aspirants' gender or race and by providing experiential-based advice on how to handle situations unique to persons of certain status configurations (e.g., sexual harassment, or subtle forms of racism). The designation "role model" was, with only two exceptions, mentioned only in discussion of a same-gender adviser or postdoctoral supervisor. Furthermore, women scholars as well as minority men, mentioned prominent individuals of their same status-configurations within their disciplines who had served as role models for them, even though they never established a mentoring relationship with them.

Both women and men valued advisers or postdoctoral supervisors who became friends as well as colleagues, but this theme was listed as an advantage of a relationship with a mentor more often by women than by men. Women valued both

women and men mentors who were also friends. The following is a particularly striking example:

> It was a close friendship as well as a working relationship. We discussed ideas, professional opportunities, husbands, children, teaching, world issues, etc. We laughed together, we cried together, we were joyous about each other's professional achievements and distraught at each other's setbacks. I was an "older" student, very close to her age, and there were similar things about our [personal] lives. I don't know how much this contributed to the closeness. She still supports me personally and professionally, even though I've been out of graduate school nearly a decade. We talk on the phone a lot, because we are on opposite sides of the country and don't see each other much. We talk about EVERYTHING.
>
> (Female sociologist, female adviser)

The following excerpt reveals similar themes:

> One of the few senior women in the field of science. A mentor, colleague, collaborator and friend, plus a leader in [a biochemical subfield].
>
> (Female chemist, female postdoctoral supervisor)

Women scholars particularly valued advisers and supervisors who were sensitive to issues facing women in the discipline or who went out of their way to support women students in environments that were not always welcoming to women. Others appreciated advisers with whom they could discuss issues of work and family balance. The following excerpts illustrate:

> He did not question by ability. He didn't suggest that I quit--even when I had a baby in my second year of graduate school. It was quite unheard of

for a women in the sciences to have children while in graduate school at the time [the early 1970s].

(Woman physicist, male doctoral adviser)

Male advisers' efforts to support women were appreciated, even when the support was limited. A woman sociologist, for example, listed as an advantage her male adviser's encouragement of her work about gender from a feminist perspective and of his defense of it to potentially-hostile other committee members, even though "....he didn't know anything at all about the topic I was studying, or, for that matter, sociological research about women."

One female chemist listed as an advantage of her male doctoral adviser that he was "one of the few male chemists who would go to lunch with a female colleague."

A sociologist wrote of her adviser:

She was amazingly honest about what it was in the profession, in the discipline, as a woman. She warned me that there would be choices I would have to make, and that they might be harder for me than for men. She knew that having a family was important to me. She was astonishingly frank about telling me things about her own life...her mistakes, her negative choices. She did that in an encouraging way.

(Female sociologist, female doctoral adviser)

Although most common in male adviser/female protege combinations, such issues were not altogether absent from men's relationships with male advisers, as in the case of a male sociologist whose postdoctoral adviser told him he would never be a first-rate scholar because he shared child-rearing with his wife and occasionally brought his two preschool children to the office.

The importance of having some one to talk with about personal as well as professional life was underscored by the number of scholars who wrote or phoned to discuss the lack of opportunities to discuss such issues and the alienation they had felt as a result. Many women scholars, for example, seemed uncertain about how to discuss pregnancy and childbirth with mentors and colleagues and many had no contact with senior women scholars who had borne children. A woman chemist wrote an elaborate description of her plan to first acquire tenure, then marry, then attempt to have two children in rapid succession--the only pattern she believed was possible for professional survival. A woman sociologist wrote of concealing an unexpected, but welcomed, pregnancy from her male adviser as long as possible for fear that he would withdraw her funding. Another sociologist conspired to keep the male adviser with whom she wanted to work from learning she was a single parent until he had signed papers to direct her dissertation. She previously had heard him disparage the commitment of women students with children.

Problematic Reltionships

Many of the problems that women reported in mentoring relationships revolved around issues of ignoring or trivializing of the women's work, insensitivity to personal-life needs of women, ignorance of substantive areas where women wished to work, paternalism, outright sexism by the mentor, and intrusion of unwanted sexual dimensions in the mentor/protege relationships.

Trivialization and Lack of Attention: Many women felt that they or their work was ignored or trivialized in comparison to men's. A woman chemist wrote about her male postdoctoral supervisor:

> More attentive to the work done by the male postdocs. They went to the meetings more often. They got introduced around in the profession.

(Female chemist, male postoctoral supervisor)

A female physicists wrote of her doctoral adviser:

He was much more interested in the research of the male students.

He gave me little attention or guidance.

(Female physicist, male adviser)

An interviewed white female sociologist complained that her doctoral adviser forgot the topic of her in-progress dissertation when he introduced her to colleagues at a professional meeting.

Insensitivity to Needs: Just as male and female advisers who were sensitive to specific needs of women in science were valued, those who were insensitive to these issues were criticized, as in the following descriptions:

Had problems with my pregnancy and childbirth my last year. Tried not to rehire me. Wrote on a form for the department that he didn't want me ending up as a bad mother and a bad researcher by trying to do two things at once.

(Female astrophysicist, male adviser)

Some female respondents noted that the lack of departmental policies on issues such as pregnancy, family leave, allocation of credit, or sexual harassment complicated their negotiations with advisers because expectations were unclear. The pathway was especially difficult for women who were "firsts": the first woman in their doctoral program, the first pregnant woman in the program, etc. Conflicts between parental duties and research training was particularly problematic for women of color, who were more likely to be older and parents when then entered graduate school.

Ignorance of Substantive Interests: Complaints of this sort were most common from women sociologists, who found that many male mentors knew little

about substantive areas where they wished to work. This was particular true when they wanted to study gender. One woman sociologist wrote:

> He was a sweet man. He tried to be helpful. He was a big zero in terms of his knowledge about my topic, though. He hadn't read anything in my field, save [a journal article published in the 1950s].
>
> (Female sociologist, male adviser)

Paternalism: Paternalism was another theme mentioned occasionally by men in relationships with male advisers and supervisors but more typically by women working with male mentors, as in the following comments:

> Turned down a postdoctoral position without my knowledge and consent because he believed the move would be a bad one for my husband (also his student).
>
> (Female physicist, male adviser)
>
> * * *
>
> Wouldn't let go when it was time to move on. Tried to restrict my job search to [nearby locales], even though I made it clear to him that this was not my desire. Had a million excuses: big cities were "unsafe," the upper Midwest was "too cold," etc.
>
> (Female chemist, male adviser)

Women in all disciplines complained of advisers or postdoctoral supervisors who tried to steer their searches for jobs or postdoctoral appointments in directions they women did not want to go, such as toward teaching colleges only, women's colleges only, nonacademic jobs only, government jobs only, or in the case of African American scholars, to historically black colleges and universities only. Such unwelcome paternalism seemed motivated by a number of factors, including a desire to keep the woman nearby, greater concern about her

husband's job prospects than hers (particularly prevalent when spouses shared an adviser), or well-meaning, but misguided, notions about what the women wanted or what would be best for them.

Sexism: Complaints of overt sexism were not frequent, appearing in only about 11 percent of the women's comments about doctoral or postdoctoral mentors, but many were dramatic. One woman described her adviser as follows:

> Hopeless sexism. Awkward with women. Incapable of collaborations with women.
>
> (Female physicist, male adviser)

A woman biochemist wrote that her male adviser saw it as his "duty" to "save biochemistry from women's influence."

Unwanted Sexual Dimensions: From the perspective of women proteges, the greatest disadvantages occurred when unwelcome sexual dimensions entered mentoring relationships. Sexual harassment was relatively infrequent (mentioned by less than 7 percent of women), but powerful and long-lasting in its consequences. All reports of actual or feared sexual harassment involved women proteges with male advisers: "He was something of a womanizer; This was well known"; "I always was wary of sexual advances"; "I think he fanned rumors (untrue) that we were lovers and this was very damaging to my relationships with other faculty and students."

A woman sociologist wrote of the personal and professional devastation she suffered when a postdoctoral adviser, whom she had moved 3,000 miles to work with, withdrew her multi-year funding when she rebuffed his sexual advances. A woman sociologist felt her career development had been limited by objection of her supervisor's wife to her receiving travel funds to attend professional

meetings that he attended. A woman physicist characterized the laboratory in which she did postdoctoral work as a discomforting "sexual playground."

Women who had experienced sexual harassment or a hostile work climate commented that they felt they had few resources to use in combatting the problem. They either endured harassment (sometimes paying a price in diminished productivity) or left the site, often sacrificing years of work and risking negative recommendations in the process. In a classic study, Pelz and Andrews (1976) found that scientific productivity could be significantly predicted by the degree of support and comfort that scientists felt in their workplaces, net of the effects of factors such as ability and quality of training. If women feel more discomfort at work than men, their productivity might fall.

Race/Ethnicity-Linked Themes

Interviews made clear that minority scientists valued similar attributes and behaviors in their doctoral and postdoctoral mentors as did nonminority scholars. Minority scholars had many of the same problematic interactions with advisers as White women experienced. Minority scientists frequently found no desirable mentors and made choices based on principles of "the lesser evil." One woman of color selected her adviser because he was the "least racist" person in the department. An African American postdoctoral scholar in chemistry believed that her good rapport with colleagues at a prestigious laboratory resulted from the fact that none were white males.

Minority scientists also were discouraged that although white supervisors rarely were the source of overt racism, they sometimes failed to intervene when racism occurred in their presence. A male African American scientists reported the following:

> Once when I was in the basement of XXX Hall. A police officer was there looking for some black guy, right in front of my professor, okay? The professor just let this guy search me and everything because he was looking for a black man. Instead of saying to [the officer], you know, he's not the guy you're looking for, you'd beter go to somebody else....I'm down there working and the guy's searching me, okay. And my professor didn't say anything.

Another African American male chemist told of being asked to relinquish a computer when a professor and his student believed he was playing games. He was in fact completing a complex programming task for his adviser, who observed the incident but did not intervene on his behalf.

Minority scientist also spoke of being on the "outer circle" in their relationships with advisers and postdoctoral supervisors. A Chicana sociologist noted that although her female doctoral adviser had an excellent reputation for mentoring all women, including women of color, the students who worked closest to her and received the most attention never were women of color. Scholars of color also complained that their advisers knew little about the substantive topics they wished to study. Again, these issues were more central for sociologists than for the physicists and chemists.

Collaboration

Research suggests that collaborating with an adviser is beneficial for advantageous first-job placement and for productivity later in the career (Long 1990). It therefore is important to examine whether women have as much opportunity to collaborate with mentors as do men. Collaboration rates vary across disciplines and are more common in the physical and natural sciences than in social sciences and humanities. While nearly all chemists had collaborated

with doctoral advisers, less than half of sociologists had collaborated with advisers on at least one publication, chapter, or grant proposal. Table 3 shows collaboration rates of women and men with advisers and postdoctoral scholars. Net of this systematic disciplinary variation, though, women were slightly less likely to have collaborated with doctoral or postdoctoral advisers (Table 3), though these differences approached statistical significance only for physicists and astronomers' collaborations with postdoctoral supervisors (p=.11). Followup questions showed that in all disciplines except physics and astronomy, men's collaborations with advisers were more elaborate than women's, involving several papers, grants, or projects. At the postdoctoral level extent of collaboration was not significantly different for women or men in any discipline.

TABLE 3 ABOUT HERE

Only in sociology were there sufficient numbers of scholars with female doctoral advisers to explore whether the gender composition of the mentoring dyad affected collaboration rates. Among sociologists, the highest collaboration rates were in dyads composed of women scholars and women mentors (56%), followed by male mentor/male student dyads (38%), male mentor/female student dyads (33%), and female mentor/male student groups (0%). Thus, there was some suggestion that women collaborated more and that same-gender dyads had higher collaboration rates than mixed-gender ones.

Other Mentors

Among survey respondents women were more likely than men to say they had mentors other than doctoral and postdoctoral advisers, and they also had significantly more other mentors in comparison with men in their disciplines. In sociology women averaged 2.1 other mentors for men's 1.9; in physics women had 1.5 others compared with men's 1.3; and chemistry women reported 1.5 compared

with men's 1.1. Although women in most disciplines had more other mentors beyond doctoral and postdoctoral advisers than did men, the distributions were significantly different only for the chemists.

Open-ended questionnaire items and interviews made clear that women sought additional mentors, in part, because those available in regular academic, departmental channels were inadequate. Minority scholars, interviews revealed, had an especially broad and diverse group of mentors and relied heavily on professional associations focused on black scientists and peers for mentoring. One African American sociolgist notes of her experiences of attending professional meetings:

> I knew all the black sociologists.... We put on panels together, you know, on professional socialization, and we had different people talk, and the best advice I ever got about issues surviving as a junior faculty came [from these events]. There was a panel that talked about those issues and I just soaked it in.

One white female sociologist identified as an important mentor "....the local and national chapters of SWS [Sociologists for Women in Society]. That's where I found people to talk through ideas, critique work, cheer me up when I needed it. Filling out this questionnaire made me realize how important that group had been to my survival." Another woman sociologist made similar comments about the Curriculum Integration Workshop at Memphis State University, a program in the 1980s to prepare scholars for teaching nonsexist, multicultural curricula. A woman chemist said an informal women in science brunch group had been more important than to her than doctoral committee members in helping her think through her dissertation project. A woman astrophysicist described publications and activities of the committee on the Status of Women in Physics as "My

lifeline. Sustaining my vision of another, more reasonable, world." Women and African American scientists in all disciplines noted the importance of various conferences or publications in journals in their disciplines that had exposed them to female role models and/or work by women.

The list of other mentors for women and for African American scholars frequently included peers, classmates, faculty outside their disciplines or universities, or persons outside of academia altogether. One woman sociologist, for example, listed as mentors two junior faculty in other social science departments (one of whom was on her doctoral committee). She had sought them out for assistance in doing feminist research when her adviser, though supportive of her project, proved to be unknowledgeable about her topic and the methods she proposed to use. Some women scholars had used "hidden mentors," working formally with a senior scholar (usually male), but in reality relying most heavily on another faculty member (usually more junior, often female). Sometimes this solution had been suggested by a junior faculty member. This was a risky strategy for both parties, however, requiring manipulation and risk of becoming embroiled in departmental politics on the part of the protege and lack of reward or recognition for mentoring activities on the part of the hidden mentor. Some women reported that junior women scholars had suggested that the protege pursue such a strategy, however.

Outside and nonacademic persons also were named as mentors. A minority male biochemist relied heavily on a faculty mentor from another university, since no one locally knew much of the minority health issues he wanted to research. Other scholars listed friends or kin who had facilitated their careers in some way as "mentors." A woman biochemist credited her mother, a high school English teacher, for "...Setting a fine example of persistence and quality work. Never giving up.

She believed in me through the rough spots when nobody else did." A minority woman chemist credited a non-relative teacher in humanities with supporting her scientific career by "....being the first person to believe that I had a fine mind and that I could do a lot with it." Similarly, a minority male chemist listed as a "mentor" distant relatives who had offered to mortgage their home to permit him to continue his undergraduate work and qualify for a graduate fellowship when his immediate family faced severe financial problems. "Mentor" appeared to have a different meaning for subgroups of scientists, with women and minorities including persons who had helped their academic progress in multiple ways, whether or not they were in formal mentoring roles within academic institutions. White men, on the other hand, tended to name only senior scholars in academia, usually their own departments, as their mentors.

On the one hand, women clearly were benefitted by the availability of mentors beyond their local departments. Many were flexible and creative in finding mentoring when this was not provided in their local departments. The ties they formed might benefit them in the future and, on a larger level, might help to create productive cross-disciplinary, cross-institutional ties. On the other hand, the fact that women, and minority male scholars, needed to search so hard for mentors suggests that their mentoring needs are not being met in many departments. Although the search for alternative mentors created beneficial relationships, women had to expend time that men did not establish such relationships. Furthermore, the relationship might be detrimental to the external mentors who might get little credit for the contribution.

Consequences of Mentoring Experience

Using the survey data, we explored the consequences of quality of mentoring and collaboration with mentors on the research productivity of women and men

scientists. We performed a series of ordinary least squares regressions, using as dependent variables measures of research productivity that are important in these disciplines: published journal articles and and receipt of externally funded research grants.

Dependent variables were measured as the total number of published articles or funded research grants a scholar had to her or his credit, whether these were solo or coauthored. Although there are debates about what constitute appropriate measures of these variables, recent work by Stephan and Levin (1992) suggests that results obtained using total counts in most instances differ little from those obtained by using counts adjusted for coauthorship or, in the case of journals, by quality. Furthermore, collaboration is the normative mode of production of work in all these disciplines.

The first set of regressions focused on doctoral advisers. Separate regressions were done for each discipline. Research productivity was predicted by the effectiveness rating, a measure of collaboration (1=one or more collaborative project with the doctoral adviser; 0=no collaboration), and gender (1=female; 0=male). Used as control variables were dummy variables for marital status (1=currently married; 0=currently unmarried) and parental status (1=one or more child currently in the household; 0=no children in the household), since prior research suggests that these variables might affect productivity (Cole and Zuckerman 1987). Since professional age is logically related to productivity, we also control for this, measured as year that the terminal degree was awarded. On this latter variable, lower numbers denote earlier degrees and hence greater professional age. A second set of equations explored the impact of effectiveness of postdoctoral supervisor and collaboration with postdoctoral supervisor for scholars in each discipline who had held postdoctoral posts. These used the same

variables as above, except that effectiveness ratings of postdoctoral supervisors and collaboration with supervisors were substituted for the comparable variables for doctoral advisers. Interaction terms are not included, since tests showed that logically-relevant interaction terms were not significant.

As Table 4 shows, there were no significant effectiveness of mentors or collaboration with mentors on productivity of journal articles for scholars in the survey sample. Gender exerts a significant effect only for chemists, where female chemists produce fewer articles than males. Professional age has significant effects in the expected direction, but neither marital or parental status affects article productivity of scholars in any discipline.

TABLES 4 AND 5 ABOUT HERE

Table 5 shows a similar pattern for funded grants. There are marginally significant effects of gender for sociologists in receipt of funded grants, in the direction of women's receiving more than men. Effectiveness of adviser exerts a marginally signficant effect on women chemists' receipt of grants, and women chemists tend toward receipt of fewer grants compared with males. Professional age significantly affects receipt of grants across discipline.

The nature of the sample makes interpretation of these results problematic, since we have only successful scientists who are working in doctoral programs in academia. Because for these scientists there are no long-range consequences of mentoring effectiveness or collaboration, we cannot conclude that these factors are unimportant in scientists' research productivity. It is possible that scientists who were less effectively mentored, or who collaborated less with mentors, never attained such posts or did not survive in them. But the findings suggest that even though women in some disciplines experience less effective mentoring compared with men and have fewer collaborative opportunities, they

nevertheless generally equal male counterparts in productivity later on. These women perhaps were mentored well enough to become productive, or overcame the consequences of less effective mentoring as their careers progressed.

TABLES 6 AND 7 ABOUT HERE

Tables 6 and 7 report results of these analyses for effectiveness and collaboration with postdoctoral mentors. These analyses could be carried out only for chemists and physicists, since only 15 percent of sociologists had done postdocs. Results are very similar to those of the above equations, with gender significantly related to less article and grant productivity for women in chemistry only but no other variables except professional age exerting a significant effect.

DISCUSSION

This study creates a complex portrait of the availability, effectiveness, and consequences of mentoring of women and minority scientists.

Women and minority scientist, overall, appear to find the mentors they need for career success, have effective mentoring relationships with doctoral and postdoctoral advisers, and find other mentors when necessary. However, they clearly experience more problems in mentoring relationships. These include difficulty in gaining access to the eminent mentors whose sponsorship can help to jump start their careers and a series of gender-and race-related difficulties in sustaining mentoring relationships within the academic system. The data from sociology suggest that women might derive special benefits from working with women. It will be interesting to track whether this pattern develops in other disciplines as women scholars become more senior and more involved in mentoring.

An optimistic implication of the findings are that women and men appear to do equally well in terms of productivity over the career cycle, when professional

age is controlled. Marriage and children do not appear to disadvantage women scholars in productivity, consistent with findings of some earlier studies. However, it is still the case that women are less apt to be married and have children than their male counterparts and many women report difficulties in planning childrearing and childbearing and in combining work and family. We continue to explore this issue in our data. Long (1990) has suggested that women who have the most complex personal-life demands might be forced out of science altogether, and hence are not represented in samples such as ours.

Patterns in chemistry are not entirely consistent, with women publishing less and receiving fewer grants when mentoring experience, professional age, and personal-life factors are controlled. There is a need for more study of this discipline to determine why this might be the case. Other cautions must be exercised in interpreting findings about effects of mentoring. First, the sample used in this study includes only successful scientists. Scientists with poor mentoring experiences might have been less likely than others to complete their degrees and to obtain jobs in Ph.D.-granting departments, even when they are highly capable (see, e.g., Keller 1977). Those with poorer mentoring experiences therefore might not be represented in this sample. Responses to open-ended questions suggest that even among these successful scientists, women are more likely than men to encounter problems in mentoring relationships. Perhaps not all women students aspiring to scientific careers have been able to overcome these problems as effectively as the women in this sample. There is a pressing need for further research, especially prospective and longitudinal studies, to explore this possibility. However, such studies will need to devote attention to the complex dynamics of mentoring relationships, not simply the availability of

potential mentors, to provide the basis of knowledge needed to design effective mentoring strategies for underrepresented groups.

References

Blackburn, Robert. 1981. "Cloning in Academe: Mentorship and Academic Careers." Research in Higher Education 15: 315-27.

Brewer, Rose. 1988. "Black Women and Feminist Sociology." The American Sociologist 20:57-70.

Cole, Jonathan. 1987. Fair Science: Women in the Scientific Community. Morningside Edition. New York: Columbia University Press.

Cole, Jonathan and Harriet Zuckerman. 1987. "Marriage, Motherhood, and Research Performance in Science." Scientific American 255 (Feb.): 119-25.

Collins, Mildred and Marsha Lakes Matyas. 1985. "Minority Women: Conquering Both Sexism and Racism." Pp. 102-123 in Jane Kahle (ed.) Women in Science. Philadelphia: Falmer.

Collins, Roger. 1983. Colonialism on Campus: A Critique of Mentoring to Achieve Equity in Higher Education. Journal of Educational Equity and Leadership 3: 277-87.

Committee on the Education and Employment of Women in Science and Engineering. (CEEWSE). 1983. Climbing the Ladder: An Update on the Status of Doctoral Women Scientists and Engineers. Washington D.C.: National Academy Press.

DuBois. Ellen; Gail Paradise Kelly; Elizabeth Laprovsky Kennedy; Carolyn Korsmeyer; and Lillian S. Robinson Feminist Scholarship: Kindling in the Groves of Academe. Urbana, Il.: University of Illinois Press.

Epstein, Cynthia F. 1970. Women's Place. Berkeley: University of California Press.

Fox, Mary Frank. 1989. "Women and Higher Education." Pp. 197-216 in Jo Freeman (ed.) Women: A Feminist Perspective. Fourth edition. Palo Alto: Mayfield.

_____. 1983. "Publication Productivity among Scientists: A Critical Review." Social Studies of Science 13: 285-305.

Goetz, Judith Preissle and Margaret LeCompte. 1984. Ethnography and Qualitative Design in Educational Research. Orlando, Fl: Academic Press.

Grant, Linda and Kathryn B. Ward. 1992. Mentoring, Gender, and Publication in Natural, Physical and Social Sciences. Final Report to the U.S. Department of Education, Office of Educational Research and Improvement, December.

Hornig, Lilli S. 1987. "Women Graduate Students." Pp. 13-22 in Women: Their Underrepresentation and Career Differentials in Science and Engineering. Washington, D.C.: National Academy Press.

Keller, Evelyn Fox. 1977. "The Anomaly of Women in Physics." In Working It Out, edited by Sara Ruddick and Pamela Daniels. New York: Random House. Critical Review." Social Studies of Science 13:285-305.

Long, J. Scott. 1990. "The Origins of Sex Differences in Science." Social Forces 68.

McGinnis, Robert and J. Scott Long. 1988. "Entry into Academia: Effects of Stratification, Geography, and Ecology." Pp. 52-73 in Academic Labor Markets and Careers, edited by David W. Breneman and Ted I. K. Youn. New York: Falmer.

Malcolm, Shirley Mahaley; Paula Quick Hall; and Janet Welsh Brown. 1979. "The Double Bind: The Price of Being a Minority Woman in Science." Pp. 94-103 in Science, Sex, and Society, ed. Ann E. Kammer, Cherlyn S. Granrose, and Jan B. Sloan. Washington: U.S. Department of Health, Education and Welfare, Project for the Advancement of Women in Science Careers.

Menges, Robert J. and William H. Exum. 1983. "Barriers to the Progress of Women and Minority Faculty." Journal of Higher Education 54:123-44.

Mirande, Alfred. 1988. "I Never Had a Mentor." American Sociologist 19.

Pelz, Donald and Frank Andrews. 1976. Scientists in Organizations. Ann Arbor, Mich.: Institute for Social Research.

Ramaley, Judith A., ed. 1978. Covert Discrimination against Women in Science. Boulder, CO: Westview Press for the American Association for the Advancement of Science.

Rosser, Sue V. 1990. Female-Friendly Science. New York: Pergamon.

Rossiter, Margaret. 1982. Women Scientists in America. Baltimore: Johns Hopkins University Press.

Science. 1992. Special Issue on Women and Science, v. 256 (March 13).

Stephan, Paula and Sharon Levin. 1992. Striking the Mother Lode in Science: The Importance of Age, Place, and Time. New York: Oxford.

Strauss, Anselm and Corbin, Juliette. 1990. The Basics of Qualitative Research. Beverly Hills, Ca.: Sage.

Task Force on Women, Minorities, and the Handicapped in Science and Technology. 1988. Changing America: The New Face of Science and Engineering Interim Report. Washington D.C..

Vetter, Betty. 1989. Women in Science: Progress and Problems. Paper presented at the annual meeting of the American Association for the Advancement of Science. Occastional Paper 89-1. Commission on Professionals i Science and Technology, Washington, D.C.

Zuckerman, Harriet. 1987. "Persistence and Change in the Careers of American Men and Women Scientists and Engineers." Pp. 123-56 in Women: Their Underrepresentation and Career Differentials in Science and Engineering, edited by Linda S. Dix. Washington D.C.: NAS Press.

Zuckerman, Harriet, Jonathan R. Cole, and John T. Bruer. 1991. The Outer Circle: Women in the Scientific Community. New York: Norton.

Table 1. Number of Respondents and Response Rates by Discipline and Gender.

	Female N (%)	Male N (%)	Total N (%)
Sociology	142 (71%)	87 (44%)	229 (57%)
Chemistry	97 (49%)	74 (37%)	166 (42%)
Physics	115 (58%)	72 (36%)	187 (47%)

Table 2. Ratings of Effectiveness of Doctoral and Postdoctoral Advisers "As a Mentor for Me" by Discipline and by Gender (By Percentage).

	Not Very Effective	Somewhat Effective	Moderately Effective	Very Effective
Doctoral Advisers				
Sociology				
Women	15%	12%	33%	40%
Men	13%	17%	26%	44%
Chemistry				
Women	10%	19%	26%	45%
Men	6%	15%	22%	57%
Physics*				
Women	21%	22%	28%	29%
Men	13%	9%	35%	43%
First Postdoctoral Adviser				
Sociology*				
Women	32%	22%	14%	32%
Men	22%	0%	22%	56%
Chemistry				
Women	11%	11%	27%	51%
Men	6%	0%	29%	65%
Physics				
Women	20%	18%	25%	37%
Men	24%	15%	31%	32%

*Denotes significant gender difference in distribution at $p<.05$.

Table 3. Rates of Collaboration with Doctoral and Postdoctoral Adviser, by Discipline and Gender.

	Female	Male
Collaborated with Adviser		
Sociology	39.8%	41.5%
Chemistry	91.7%	96.7%
Physics	81.2%	82.4%
Collaborated with Postdoctoral Adviser		
Sociology	38.1%	50.0%
Chemistry	91.5%	96.1%
Physics	65.9%	79.7%

* Denotes significant at $p<.05$

Table 4. Impact of Effectiveness of Doctoral Adviser, Collaboration with Adviser, Gender and Marital and Parental Status on Total Articles Published for Scientists in Three Disciplines, with Professional Age Controlled. (Unstandardized Ordinary Least Squares Regression Coefficients)

	Sociologists	Chemists	Physicists
Intercept	71.4***	277.3***	154.0***
Gender	-3.7	-.2*	5.1
Effectiveness of Adviser	1.8	4.3	3.0
Collaboration with Adviser	.5	.3	.34
Married	5.2	-4.8	14.98
Children	-2.8	1.6	-1.99
Year of Degree	-.8***	-3.0***	-2.00***
R-square	.20	.22	.26
(N)	(206)	(141)	(152)

*** Statistically significant at p<.001
** Statistically significant at p<.01
* Statistically significant at p<.05

Table 5. Impact of Effectiveness of Doctoral Adviser, Collaboration with Adviser, Gender and Marital and Parental Status on Total Research Grants Funded for Scholars in Three Disciplines, with Professional Age Controlled. (Unstandardized Ordinary Least Squares Regression Coefficients)

	Sociologists	Chemists	Physicists
Intercept	11.5***	30.6***	24.6***
Gender	1.4+	-3.2+	.4
Effectiveness of Adviser	.4	-1.6+	.8
Collaboration with Adviser	.3	3.4	.1
Married	1.2	.2	.7
Children	.3	-.4	-.4
Year of Degree	-.2	-.2***	-.3***
(N)	(204)	(139)	(151)
R-square	.07	.08	.14

*** Statistically significant at p<.001
** Statistically significant at p<.01
* Statistically significant at p<.05
+ Statistically significant at p<.1

Table 6. Impact of Effectiveness of Postdoctoral Supervisor, Collaboration with Postdoctoral Supervisor, Gender and Marital and Parental Status on Total Articles Published for Chemists and Physicists, with Professional Age Controlled. (Unstandardized Ordinary Least Squares Regression Coefficients)

	Chemists	Physicists
Intercept	316.80***	171.3***
Gender	-22.0*	3.1
Effectiveness of Postdoctoral Supervisor	6.2	1.2
Collaboration with Postdoctoral Supervisor	-15.8	.4
Married	-8.5	8.2
Children	2.0	11.4
Year of Degree	3.4***	1.94***
R-square	.33	.33
(N)	(114)	(131)

*** Statistically significant at p<.001
** Statistically significant at p<.01
* Statistically significant at p<.05

Table 7. Impact of Effectiveness of Postdoctoral Supervisor, Collaboration with Postdoctoral Supervisor, Gender and Marital and Parental Status on Total Research Grants Funded for Chemists and Physicists, with Professional Age Controlled. (Unstandardized Ordinary Least Squares Regression Coefficients)

	Chemists	Physicists
Intercept	34.9***	28.4***
Gender	-2.9*	.1
Effectiveness of Postdoctoral Supervisor	.1	-.4
Collaboration with Postdoctoral Supervisor	.4	-1.9
Married	.2	-2.1
Children	-.4	-.4
Year of Degree	-.4***	-.2***
R-square	.33	.33
(N)	(113)	(130)

*** Statistically significant at p<.001
** Statistically significant at p<.01
* Statistically significant at p<.05